CLAIMS

What is claimed is:

1. In a hearing aid a condenser microphone formed of a diaphragm comprised of a metallic film on a plastic substrate which extends laterally adjacent to a generally planar surface of a hearing aid housing and a backplate disposed adjacent to the diaphragm, one or more openings in the planar surface permitting sound waves to impinge on said diaphragm, said diaphragm being divided into a plurality of active diaphragm areas, to convert diaphragm vibrations, from the active areas, caused by sound impinging on said areas, into electrical impulses which are spatially coupled from the backplate to signal processing electronics.

2. A hearing aid as in claim 1, wherein said microphone is an electret type microphone.

3. A hearing aid as in claim 1, wherein bumps on said backplate functionally divide said diaphragm into dissimilar shaped active diaphragm portions.

4. A hearing aid as in claim 1, wherein said backplate functionally divides said diaphragm into active diaphragm portions of dissimilar sizes

5. A hearing aid comprising an electret microphone formed of a metallic coated diaphragm laterally disposed at one end of a housing opposite a backplate and wherein said housing includes an inwardly extending sidewall and a front wall partly enclosing a back chamber which is acoustically sealed by a printed circuit board laterally extending across and contacting a periphery of said sidewall at an open end of the housing, and wherein electronic components for the hearing aid are located on said printed circuit board and an electrical connection is formed

between said backplate and a component on a first side of the printed circuit board.

6. A hearing aid as in claim 5, wherein said electrical connection comprises an elongated resilient conductive member which at one end thereof is fastened to the printed circuit board and makes resilient electrical contact at the other end thereof with the backplate.

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7. A hearing aid as in claim 6, wherein the elongated resilient conductive member is fastened to the backplate by electrically conductive epoxy.

8. A hearing aid as in claim 6, wherein the elongated resilient conductive member is added to or formed in the backplate.

9. A hearing aid as in claim 6, wherein said elongated resilient member is made of beryllium copper.

10. A hearing aid as in claim 5, wherein said electrical connection includes a buffer/amplifier which is connected between the backplate and the printed circuit board component.

11. A hearing aid as in claim 6, wherein the resilient member is made of a .001" thick copper foil, which includes a base which is soldered to the printed circuit board and a bent-up portion integrally projecting from the base to make contact with the backplate in assembly.

12. A hearing aid as in claim 11 wherein the backplate includes an electrically conductive epoxy dot applied to the backplate on its underside facing the printed circuit board so that the resilient member bent-up portion penetrates the conductive epoxy dot in assembly.

13. A hearing aid as in claim 11, where the bent-up portion of the resilient member is gold-plated to facilitate retention of contact with the backplate during use.

14. A hearing aid as in claim 11, wherein the backplate includes a depression in the backplate to accommodate the resilient member contact.

15. A hearing aid as in claim 6, wherein the resilient member is made of a metallic wire with a ring-shaped formation soldered to the printed circuit board and including a lead portion projecting from the ring and contacting the backplate in assembly.

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16. A hearing aid as in claim 5, wherein said electrical connection comprises a first electrically conductive epoxy dot deposited on the backplate and a second electrically conductive epoxy dot aligned with the first electrically conductive epoxy dot and deposited on the printed circuit board so dimensioned that the epoxy dots press into each other and fuse and amalgamate to make an electrical contact during assembly.

17. A hearing aid as in claim 5 wherein said electrical connection comprises a lanced member formed in said backplate to project towards the printed circuit board, and an electrically conductive epoxy dot formed on said printed circuit board, in such a manner that the lanced member penetrates said epoxy dot and sets in that manner to maintain continued electrical contact during use.

18. A hearing aid as in claim 5 where said electrical connection comprises a relatively small plastic cube formed on electrically conductive leads which are wrapped around and project from the cube, the cube being fastened to the printed circuit board with an electrically conductive lead projecting from the cube to contact the backplate electrode to make said electrical connection.

19. A hearing aid microphone diaphragm comprising a metallic coated membrane having a front face and a back face, and a backplate mounted opposite the back face of the diaphragm and having a plurality of members which contact the membrane to define locations of a plurality of active diaphragm areas which are formed out of the single diaphragm and which produce a combined output for coupling to electrical components of the hearing aid.

20. The hearing aid microphone diaphragm of claim 19 in which the combined output has at least two fundamental resonant frequencies.

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21. The diaphragm of claim 19 having plural dissimilar shaped active diaphragm areas.

22. The diaphragm of claim 19 having plural dissimilar sized active diaphragm areas.

23. The diaphragm of claim 19 having four sector-shaped active diaphragm areas and a central circular active diaphragm area.

24. In a hearing aid, a microphone formed of a diaphragm and a backplate extending in a plane adjacent to each other and proximate and parallel to a surface of a faceplate of a hearing aid enclosure, the microphone contained in a housing and wherein a plurality of sound openings are formed in the faceplate of the enclosure for admittance of acoustic waves which are transduced by said microphone into electrical impulses and coupled from said backplate to signal processing circuits in a said housing.

25. The hearing aid of claim 24 wherein said openings are flared on one or more surfaces thereof to reduce wind turbulence.

26. The hearing aid of claim 24 wherein vibration isolation material is disposed between the housing and the proximate enclosure surface.

27. The hearing aid of claim 26 wherein the material also has acoustic damping properties selected to dampen certain frequency resonance responses of the microphone.

28. A low noise microphone transducer having electrically adjustable sensitivity.

29. The transducer of claim 28 in which a sensitivity is controlled by changing a voltage applied to a diode coupled to a voltage divider circuit driven by a signal output of the transducer.

30. A low noise microphone transducer having a large diaphragm which drives a voltage divider circuit including a series of capacitors and transistors switches for controlling the capacitance of the circuit, thereby, to control the sensitivity of the transducer.

31. The hearing aid of claim 5 in which the circuit board is formed of a glass epoxy substrate.

32. A low noise microphone transducer having a large diaphragm which drives a voltage divider circuit including a variable capacitance diode.

33. The transducer of claim 32 in which a sensitivity of the transducer is controlled by changing a voltage applied to the diode.

34. A low noise microphone transducer having a large diaphragm which drives a voltage divider circuit including a series of capacitors and transistors switches for

controlling the capacitance of the circuit, thereby to control the sensitivity of the transducer.

35. The hearing aid of claim 5 in which the back chamber is subdivided by an additional circuit board extending laterally across the sidewalls of the housing.

36. A hearing aid comprising:

a hearing aid enclosure;

a housing of lateral width "W" and longitudinal length "L" disposed at a proximal end of said enclosure, a transducer formed of a diaphragm comprising an electrically conductive membrane disposed opposite a conductive backplate, said membrane and diaphragm extending in a plane parallel to and proximate to and opposite a faceplate of said enclosure having sound openings formed through said faceplate.

37. The hearing aid of claim 36 wherein the housing is electrically conductive and is formed of a front surface open to a said faceplate and a sidewall extending longitudinally inward from said faceplate; a PCB having a conductive ground plane extending across said sidewall in electrical communication with the housing to form an acoustic seal for the transducer; electrical components to process signals generated by said transducer provided on said PCB; and wherein said housing and PCB form an EMI shield around said components and transducer.

38. The hearing aid of claim 36 wherein the ratio of the area of the housing opposite the faceplate to the area of the faceplate is at least 0.5.

39. The hearing aid of claim 36 wherein the housing has a greater lateral dimension than longitudinal dimension.

40. A microphone assembly for a hearing aid comprising a diaphragm having a front face and a back face; a backplate laterally disposed adjacent to said diaphragm; an electrically conductive housing having a front surface proximal to said front face, the housing having a lateral opening at a distal end which is acoustically sealed by a first PCB having a ground plane extending across said opening to form a back chamber, the ground plane being in electrical contact with said housing to provide an EMI shield for an electrical components on said PCB.

41. The assembly of claim 40 wherein the components include signal processing components for the hearing aid.

42. The assembly of claim 40 wherein the components include an integrated circuit which performs a buffer and amplification function.

43. The assembly of claim 40 wherein an additional PCB having a ground plane extending across sidewalls of the housing and in electrical contact thereto is disposed proximally adjacent to said backplate, said additional PCB having a buffer circuit disposal therein with an electrical connection from said backplate to an input to said buffer circuit.

44. A method of forming a hearing aid microphone comprising the steps of:

providing a diaphragm formed of a metallic film on a plastic substrate, extending the diaphragm laterally adjacent to a generally planar surface of a hearing aid enclosure;

providing a backplate adjacent to the diaphragm;

forming openings in the planar surface to permit sound waves to impinge on said diaphragm;

functionally dividing said diaphragm into a plurality of diaphragm areas, to convert diaphragm vibrations from the active areas caused by sound impinging on said areas into electrical impulses; and

collecting said impulses with an electrode coupled to the backplate.

45. A method as in claim 44, wherein bumps are provided on said backplate to functionally divide said diaphragm into active diaphragm portions.

46. A method of forming hearing aid comprising the steps of:

providing an electret microphone by forming a metallic coated diaphragm opposite a metal backplate;

laterally disposing the diaphragm and backplate at one end of a housing which includes a sidewall extending from a front wall;

extending a printed circuit board laterally across and contacting said sidewalls to acoustically seal an open end of the housing with said printed circuit board;

providing electronic components for the hearing aid on said printed circuit board; and

forming an electrical connection between said backplate and a component on the printed circuit board.

47. A method as in claim 46, wherein said electrical connection comprises an elongated resilient member including the step of fastening one end thereof to the printed circuit board in an electrically conductive manner and makes resilient electrical contact at the other end thereof with the backplate electrode.

48. A method of forming a hearing aid microphone comprising the steps of:

providing a single diaphragm by coating metal on a membrane having a front face and a back face;

mounting a backplate opposite the back face of the membrane;

contacting the membrane with a plurality of members on the backplate to define locations of a plurality of active areas to produce signal outputs;

spatially combining the outputs; and

coupling the outputs to electrical components of the hearing aid.

49. A method of forming a hearing aid comprising the steps of:

forming a microphone by providing a large area diaphragm and a backplate extending in a plane adjacent to each other, disposing the diaphragm and backplate proximate to a surface of a microphone enclosure, forming sound openings in the enclosure opposite the diaphragm for admittance of acoustic waves which are transformed by said microphone into electrical impulses at said backplate, coupling the impulses from said backplate to signal processing circuits in the enclosure.

50. A method of providing a low noise microphone transducer comprising the steps of forming a large diaphragm; driving a voltage divider circuit with said diaphragm, providing a series of capacitors and transistors switches for controlling the capacitance of the circuit, thereby, to control the sensitivity of the transducer.

51 The method of claim 41 wherein the diaphragm is subdivided into smaller areas by a diaphragm support member.

52. The method of claim 51 wherein the diaphragm is glued to the support members.

53. The method of claim 45 in which ridges are provided on said backplate to functionally divide said diaphragm into active diaphragm portions.

54. The method of claim 45 in which the diaphragm areas are non-circular in shape.

55. The hearing aid of claim 24 in which the housing has a front face located opposite the plurality of sound openings with a large aperture therein between the enclosure faceplate and the diaphragm and wherein the total area of the front face of the housing is close in size to the total area of the faceplate.

56. The hearing aid of claim 26 wherein the material is substantially acoustically transparent.

57. The hearing aid of claim 24 wherein the sound openings are smaller than about 40 mils in diameter.

58. The hearing aid of claim 24 wherein the sound opening range in size from about 15 to 30 mils in diameter.

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59. The hearing aid of claim 24 wherein the sound openings are flared on the interior of the enclosure.

60. The hearing aid of claim 24 wherein the sound openings are flared on the exterior of the enclosure.

61. The hearing aid of claim 24 wherein the sound openings are flared both the exterior and interior of the enclosure.

62. The hearing aid of claim 5 wherein the printed circuit board is sealed to the housing by compliant adhesive.

63. The hearing aid of claim 62 wherein the printed circuit board is sealed to the housing by conductive epoxy.

64. The hearing aid of claim 5 wherein the printed circuit board is acoustically sealed by a pressure contact between the board and the housing using an intermediate member.

65. The hearing aid of claim 64 wherein the pressure contact is maintained by tabs extending from housing sidewalls and clamped onto a ground plane formed on an exterior side of the board.

66. The hearing aid of claim 5 in which the electrical connection comprises a ground plane on the printed circuit board which shields the interior of the housing from electromagnetic interference.

67. The hearing aid of claim 40 including a second PCB disposed laterally adjacent the first PCB and wherein a JFET buffer is mounted on the first PCB.

68. The hearing aid of claim 67 wherein substantially all the electrical components required for a functional hearing aid other than a battery or a receiver are mounted on a substrate of the second PCB.

69. The hearing aid of claim 68 including a cover over the second PCB and electrically sealed to the housing about a periphery thereof.

70. A method of EMI shielding a microphone assembly containing electrical components comprising the steps of:

housing the microphone assembly in an open ended metal cover;

mounting components on a first side of a PCB opposite a second side containing a ground plane; and

forming an electrical connection between a periphery of said cover and said ground plane.

71. The method of claim 70 wherein the connection is made by conductive epoxy.

72. The method of claim 70 wherein the connection is made by soldering.

73. The method of claim 70 wherein the connection is made by welding.

74. The method of claim 70 wherein the connection is made by pressure contact.

75. The hearing aid of claim 5 wherein the component on the first side of the PCB is a JFET buffer and other components are mounted on a side of the PCB opposite the first side.

76. The hearing aid of claim 75 wherein the PCB also forms an acoustic seal for a back chamber of the assembly.

77. The hearing aid of claim 76 wherein a further electrical connection is made from the JFET to component on the opposite side through a via on the PCB.

78. A method of forming a microphone assembly for a hearing aid comprising the steps of:

providing a circular housing cover having an axially indented circular portion extending radially inward from the periphery of the cover;

inserting a diaphragm and annular support frame into the cover so that the frame contacts the indented circular portion, thereby providing a predetermined spacing between the cover and the diaphragm;

inserting a backplate into the cover so that a circular ridge extending radially inward about a periphery of the backplate abuts the periphery of the frame to establish a space between an inner central surface of the backplate and an adjacent surface of the diaphragm;

clamping the periphery of the backplate against the diaphragm and cover by a mounting ring which abuts the backplate.

79. The method of claim 78 wherein the mounting ring is press fit into an inner sidewall of the cover.

80. The method of claim 78 wherein a peripheral edge of the mounting ring is formed with projections which abut an inner sidewall of the housing and which collapse when an open end of the cover is sealed by an annular PCB extending across the open end.

81. The hearing aid of claim 10 in which the buffer amplifier is a JFET mounted on a sidewall of the housing.

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82. A microphone module for a hearing aid in which all the electrical components required for a functional hearing aid other than a battery and a receiver are contained along with a microphone in a single EMI shielded housing.

83. A microphone module for a hearing aid in which all the electrical components required for a functional hearing aid excluding a receiver and a main power source are contained along with a microphone and one or more supplemental cell power sources in a single EMI shielded housing.

84. The microphone module of claim 83 wherein the cell sources are electrochemical cells.

85. The microphone module of claim 83 wherein the cell sources are solar type cells.

86. The microphone module of claim 85 wherein the solar type cell sources comprise a solar cell array.

87. The microphone module of claim 83 wherein the components include an amplifier and at least one filter capacitor.

88. The microphone module of claim 87 including a voltage regulator.

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89. The microphone module of claim 88 in which the voltage regulator is a zener diode.

90. The hearing aid of claim 6 in which the resilient member is gold plated.